Summer 1955

South Dakota Farm and Home Research

Agricultural Experiment Station

SOUTH DAKOTA
FARM and HOME Research

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SOUTH DAKOTA
FARM and HOME Research
A REPORT OF PROGRESS

Vol. VI SUMMER, 1955 No. 4

In This Issue

On the Cover

Your cattle like to take a little time off, too. Provide them with good pasture and they can relax part of the day as are the Angus on our cover. It will mean better production, too.

Two articles about cattle feeding are in this issue. On page 84 G. O. Gastler discusses the need for cobalt in our grasses and J. K. Lewis reports on vitamin A supplementation of range cows on page 98.

Mailing List

We are revising our South Dakota mailing list. If you haven't returned the pink card we sent or didn't get one, please write us if you wish to continue receiving our Quarterly and other publications.

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SOUTH DAKOTA FARM AND HOME RESEARCH will be sent free to any resident of South Dakota in response to a written request to the editor, Agricultural Experiment Station, South Dakota State College, Brookings, S. D.

Dear Folks:

The summer season is an opportune time to observe much of the agricultural research activities at the State Experiment Station and the outlying Substations or Farms throughout the state.

Recently farmers from the eastern half of the state attended the Agronomy Field Day at the State College Experiment Station. Field days are still to be held at the outlying South Dakota Substations and Farms during the balance of the summer. A schedule of these field days is as follows:

August 4—Antelope Range Field Station in Harding County

August 25—Weed Farm, near Gary

August 26—Irrigation Development Farm, Redfield

Sept. 1—Weed Farm, near Brentford

Sept. 14—Range Field Station, Cottonwood

Sept. 15 — Central Substation, Highmore

Sept. 16—North-Central Substation, Eureka

Sept. 23—Livestock Research at the Reed Ranch, north of Presho

Contact your County Agent for a more detailed statement regarding the field day activities at the Station nearest to you.

During the early part of August the Russian delegation that is making a study of Midwest agriculture will spend about 4 days in South Dakota visiting farms in Brown, Marshall, Codington, and Deuel Counties. During the forenoon of August 5 the Experiment Station will be host to the delegation, where they will view research activities on crops, livestock, and farm buildings.

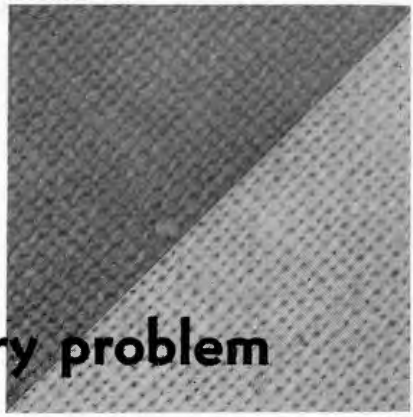
Cordially,

I. B. Johnson

Director

HARD WATER

...a common laundry problem



The upper piece of cloth was washed in hard water, the lower in softened water.

LILLIAN LUND[1]

HOMEMAKERS in South Dakota struggle with hard water in daily living, but on washday it is especially troublesome. Despite using the best possible laundry procedures, the homemaker still may have clothes that are not as white and bright as she would like.

To help the homemakers with these problems, experimental work has been carried on. Numerous aspects have been studied and some of the findings may help answer a few of the questions often raised.

In working with hard water it is necessary to have some unit of measure or description for water hardness. Hardness can be expressed as calcium carbonate in either grains per gallon or parts per million (p.p.m.). Natural waters have been classified as is shown in Table 1. Most of the water in South Dakota is in the excessively hard group. It is not unusual to find water more than 100 grains per gallon in hardness.

Softening Hard Water

Hard water must be softened in some way to be used for cleansing purposes. The early method of adding lye to soften water is not recommended, as it may injure fabrics, cause fading, and not completely remove the hardness. It is dangerous as well as inconvenient.

A more modern method is to use an ion exchange tank where hard water flows through zeolite or other ion exchange resin. Such a process removes the minerals which cause the hardness. This method is not practical if water is so hard that it is necessary to regenerate the tank every few days.

In the absence of running water some other method must be used. Packaged softeners can be added to the water, but effective results are not always obtained since there can be no definite recommendation of the exact amount of softener

[1]Acknowledgement is given Alexandra Semeniuk for her assistance on this project.

Table 1. Classification of Natural Water in Regard to Hardness

Relative Hardness	Grains/Gal.	Parts/Million
Soft water	0 to 3	0 to 55
Moderately soft	3 to 6	55 to 100
Moderately hard to hard	6 to 12	100 to 200
Hard to excessively hard	12 to 30 and above	200 to 500 and above

needed, especially for our excessively hard waters. As water hardness may vary from day to day, the proportions of softener needed will vary.

Soaps, likewise, can be used to soften water. However, considerable soap must be added to remove the hardness, and an additional quantity of soap is needed for cleansing. This is expensive and not practical where water is very hard.

A more recent development is the synthetic detergent, sometimes referred to as a "syndet." It dissolves in hard water without forming a scum or curd.

The launder-ometer is used to test soil removal of different methods of washing.

Methods Used

It was not possible, nor was it the purpose of the study, to evaulate all types of packaged softeners, soaps, and synthetic detergents. Several products were used and those showing promising results were selected for further investigation. In the preliminary work a launder-ometer, in which many samples can be run at the same time, was used. A uniform method of laundry procedure was developed. Samples were washed for 15 minutes at 140°F., followed by three 2-minute rinses at 120, 100, and 80°F.

There are several types of specially soiled fabrics available. The one most suitable for this particular study was selected. Amount of soil in the sample was indicated in units using a light reflectance meter which showed differences too small to be detected by visual observation. The differences in the light reflectance readings of the fabric before and after laundering showed the amount of soil removed.

The change in the appearance of the sample was from a dark gray before washing to a lighter gray after washing. This indicates soil removed and does not necessarily give evidence to the degree lightly soiled or white fabrics would retain their original appearance if washed under these same conditions.

For effective soil removal, neither too much nor too little softener can be used.

Too Much Softener May Affect Results

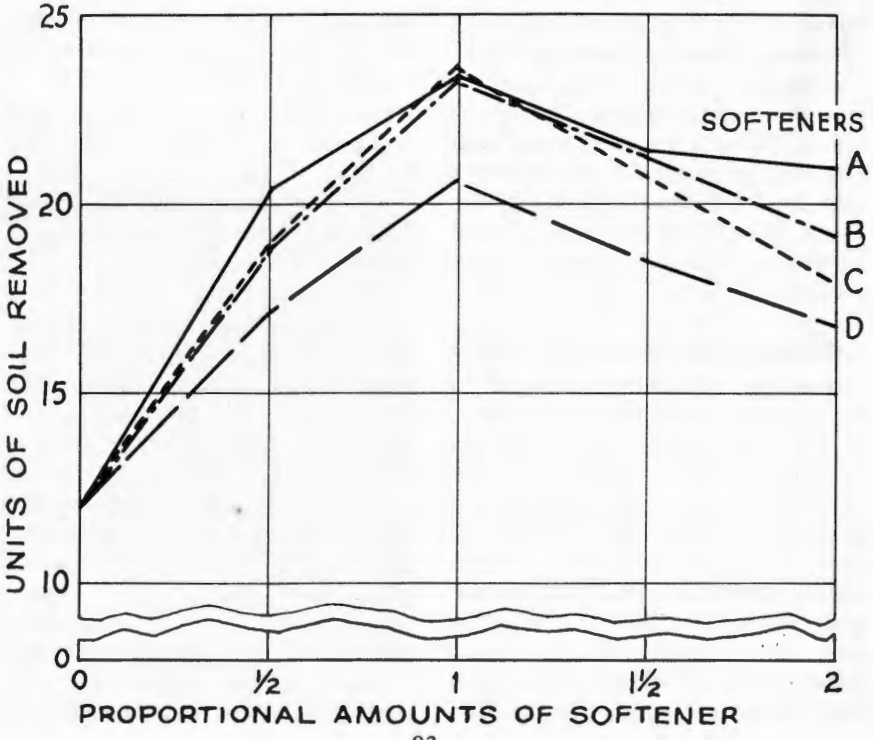
Since there is no definite rule the homemaker can follow when using packaged softeners, one object of this investigation was to determine whether an excess of softener would affect washing results.

Several types of softeners were selected for use in the study. Each differed in the amounts needed to soften water. The amount required to produce zero hardness was determined for each type. Designating this amount as 1, proportional quantities of ½, 1, 1½, and 2 were used in one experimental series. Results are shown graphically in the chart.

Water having a total hardness of 60 grains per gallon was used in this series. Only fair soil removal (12 units) was obtained when no soft-

Continued on page 96

Amount of soil removed by varying amounts of softener.



COBALT in our grasses

GEORGE GASTLER

THE POOR CONDITION of cattle and sheep grazing certain areas in various parts of the world worried farmers and scientists for many years. When it was discovered that the lack of cobalt in the pastures and feeds of these areas was the cause, people interested in animal nutrition began to give it more attention.

Ruminant Requirement Is Small

Not much cobalt is required in the rations of cattle and sheep. Exact amounts are not known, but it appears that for sheep the ration should contain at least .07 parts per million of cobalt and for cattle at least .04 parts per million. When this amount is not present these animals gradually lose their appetites and fail to gain properly. In cases of severe and prolonged deficiency they become emaciated and finally anemic. Supplying a small amount of cobalt in their ration prevents or corrects the condition.

Cobalt deficiency disease was first explained in Australia and New Zealand. Then other parts of the world were also found to be cobalt deficient, including some areas of the United States.

Experiment Station bulletin 425 describes cobalt feeding experiments with lambs at Brookings in 1948-49 and at Newell from 1949 through 1951. At Brookings no response was obtained from feeding cobalt, while at the U. S. Newell Field Station, Newell, a response was indicated. This work suggested the need for cobalt analyses of our pasture and grazing lands. Investigations were begun to establish whether or not deficiencies in this element might be reducing the income from our grazing animals.

Some of the results are reported here.

Plant Studies Are Made

Reliable methods for determining the amount of available cobalt in soils have not been developed. Therefore it was decided that plants rather than soils should be analyzed.

Determination of the small amount of cobalt in plants is a lengthy procedure. It was immediately obvious that only a limited number of analyses could be made each year. To start with, therefore, samples have been collected from various substations. To allow for comparisons between the various areas and from 1 year to the next, western wheatgrass collected during July was used for the analyses.

Not all the samples collected have been analyzed as yet, but some of the results obtained are summarized in Table 1. These results, although preliminary, have two points of interest.

One of the many steps in analyzing grass for cobalt content is shown in this picture.

The largest number of samples analyzed was from the substations. A rather wide variation in the cobalt content of western wheatgrass was found in these samples. At least some of the samples from each location contained less than .04 parts per million of cobalt, while some contained more than .07 parts per million. The highest value obtained for this grass to date has been .32 parts per million, which is also higher than for any other type of plant thus far analyzed.

Average values indicate we may expect to find areas in the state where some pastures or ranges do not furnish the necessary cobalt, at least for sheep. However, before this can be said with certainty, more analyses will be needed and results for other plant species obtained also.

Some analyses on a number of other plant species have already been made. These plants were collected at a single location along with western wheatgrass. The results indicate there is probably a difference between species as to their ability to absorb cobalt from soils. However, they do not indicate western wheatgrass is normally any lower in cobalt content than other grasses or common edible range plants. These studies will be continued to clarify the picture.

Trace Mineralized Salt Is Insurance

Trace mineralized salt is being used more and more commonly for livestock. As a general rule, it is used whether trace mineral defi-

Continued on page 97

Will Irrigation Pay IN CENTRAL SOUTH DAKOTA?

Rex D. Helfinstine

Irrigation for central South Dakota farmers appears to be nearer. The expected completion of Oahe Dam across the Missouri River north of Pierre brings irrigation closer to realization. Plans are being made to divert water from this reservoir to the James River Valley. But before these works are built, irrigation districts must be formed by favorable vote of the farmers and contracts made for operation and for repayment of the costs allocated to irrigation.

A cooperative study was made recently by the South Dakota Agricultural Experiment Station and the Production Economics Research Branch of the Agricultural Research Service to compare, in terms of profitableness, improved dryland farming with potential irrigated farming for the years to come. This information should help farmers evaluate the future of irrigation in central South Dakota.

1950 Survey

Information about present dryland farming and typical farm situations was obtained in a survey by the Agricultural Economics Department in 1950. One hundred sixteen farmers were interviewed. Information on improved dryland farming practices and the possibilities of improved crop yields and livestock production was assembled from Experiment Station results and the experience of farmers.

Estimates of practices and yields as well as costs and returns under irrigation were based on information from similar irrigation projects in

Nebraska, Montana, and North Dakota, but they were modified to fit expected conditions in central South Dakota. Crop yields obtained on irrigation development farms near Huron and Redfield in the last 5 years also were considered in these appraisals.

Preliminary information from surveys made by the Bureau of Reclamation indicated the distribution of arable soils in the area proposed for irrigation as shown in Table 1.

Drainability is an important factor so far as irrigability of land is concerned. Studies of this factor are continuing and the results may modify the proportion of land in each class as well as the total acreage considered irrigable. In connection with these studies, the Bureau of Reclamation recently engaged a board of specialists to review their findings on drainability. This review board concluded that the glacial till soils north of Miller were not sufficiently drainable for irrigation. Accordingly, the Bureau of Reclamation has decided to concentrate its investigations of irrigation upon the lake plain area near Redfield and Aberdeen.

Table 1. Distribution of Arable Soils in the Area Proposed for Irrigation

Land Class	Percent
1	9.6
2	21.0
3	26.1
4 (questionable arability)	7.0
5	4.2
6 (non-arable)	32.1
Total arable (classes 1, 2, 3, 5)	**60.9**
Total land, all classes 1,122,869 acres	

Crop Yield Estimate

Estimates of the average yields of crops to be expected under irrigation and under improved dryland farming are given in Table 2. Corn, alfalfa hay, and pasture are expected to show the greatest relative response to irrigation. These crops make more of their growth in July and August, the period when natural rainfall is most likely to be deficient. The small grains—wheat, oats, and barley—make more of their growth in spring and early summer.

Corn, wheat, barley, and alfalfa likely will continue to be prominent in the cropping system under irri-

Table 2. Estimated Average Yields of Crops Under Irrigation and Under Improved Dryland Farming, Oahe Area*

Crop	Under Irrigation†						Under Improved Dryland Farming§
	Class 1 Land	Class 2T Land	Class 3T Land	Class 2S & 2ST Land	Class 3S & 3ST Land	All‡ Classes	
Corn, grain (bu.)	54	51	48	40	36	47	16
Barley, grain (bu.)	37	35	33	32	30	34	23
Wheat (bu.)	27	26	24	22	20	24	15
Oats, grain (bu.)	50	48	44	44	40	45	28
Alfalfa, hay (ton)	4.0	3.8	3.6	3.2	3.0	3.5	1.4
Potatoes (bu.)	250	225	215	190	‖	223	#
Sugar beets (ton)	13.0	12.5	11.6	10.4	‖	12.0	#
Pasture** (AUM)††	———	———	———	———	———	7.0	2.8

*Estimated by committee of agronomists at the Experiment Station.
†When grown in a rotation including ⅓ legumes and all crops fertilized with 100 pounds of 0-43-0 fertilizer annually.
‡Average weighted by proportion grown on each land class.
§When grown in a rotation including 1/10 legumes and fertilized with 100 pounds of 16-20-0 fertilizer annually.
‖Land class considered not suitable for potatoes or sugar beets.
#Crops not generally grown commercially under dry farming.
**Not estimated separately by land class. In general would show same relationship as alfalfa hay.
††Animal-unit months, or the quantity of feed required for one mature cow or its equivalent for 1 month.

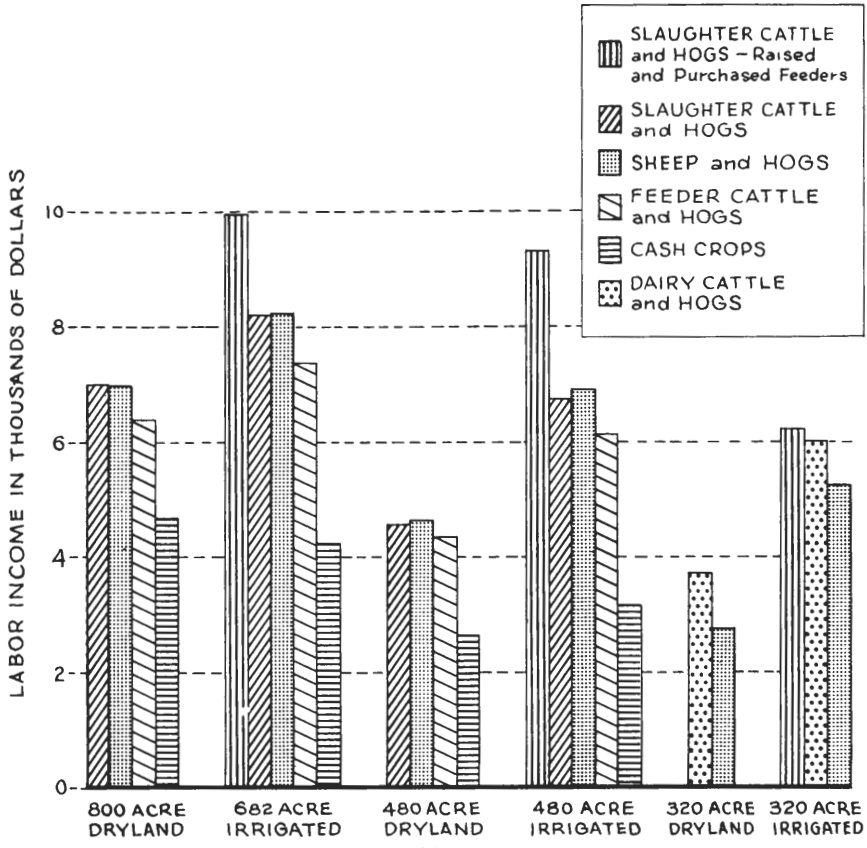
gation farming. Feed crops will be needed to supplement native range and irrigated pasture in growing and fattening livestock. Wheat will continue to be grown as a cash crop, at least to the extent necessary for rotation purposes. In addition to crops now grown in the area, sugar beets and potatoes are possibilities. Present estimates indicate satisfactory yields, but markets for these crops will have to be developed.

In working out probable incomes for these future farming systems a projected level of prices was assumed. These prices were estimated by the U.S. Department of Agriculture for use in river basin studies. In general, they approximate 1949 prices with a 1 to 1 ratio of prices to costs ($22.00 for choice yearling slaughter steers, $16.65 for hogs, $1.55 for wheat, $1.20 for corn, and $0.65 for oats).

Farm Sizes

Three sizes of farms were found to be typical of the area: 320 acres, 480 acres, and 800 acres. These sizes are likely to continue to be impor-

Comparison of labor income from various organizations and sizes of farms under dryland and partial irrigation, central South Dakota, calculated on projected price level.



tant under irrigation. They were analyzed, in the study already mentioned, under dryland and irrigated conditions and with various organizations but for illustration in this article only the 480-acre cattle-hog farm will be used.

This 480-acre farm is assumed to have 330 acres of cropland and 145 acres of range pasture and hay. It also would have 288 acres of irrigable land—48 acres of class 1, 107 acres of class 2, and 133 acres of class 3. The cropping system for this farm under partial irrigation and under improved dryland farming would have the acreages of various crops shown in Table 3.

Table 3. Cropping Systems of 480-Acre Farm Under Partial Irrigation and Under Improved Dryland Farming

Type of Farm	Acres Dry Cropland	Acres Irrigated Cropland
Dryland Farm		
Corn	99	
Barley	106	
Wheat	92	
Alfalfa	33	
Irrigated Farm		
Corn	13	144
Wheat	25	48
Alfalfa	4	96

The dryland farm would have a 7-cow beef breeding herd on the range pasture and 30 sows on alfalfa pasture. The partially irrigated farm would have either a 37-cow beef breeding herd or a 17-cow herd and 59 purchased feeders on the range pasture and irrigated pasture, as well as 30 sows on irrigated alfalfa pasture.

Average Investments

Total average investment would be $55,600 on the irrigated farm where all cattle were raised and $55,200 where the cattle were both raised and purchased (Table 4). In contrast, total average investment on the dryland farm would be $27,900. Labor requirements would be 408 man-days a year where all cattle are raised or 393 man-days where cattle are raised and purchased on the irrigated farm. On the dryland farm 180 man-days of labor would be required. Labor income (return to operator for his labor and management) would be $4,539 on the dryland farm and $6,755 on the irrigated farm where cattle are raised, or $9,310 where cattle are raised and purchased. Capital income (returns to operator for his investment expressed as percentage of investment) would be about 16 percent on the dryland farm and 12 (cattle raised) or 17 percent (cattle raised and purchased) on the irrigated farm.

As these comparisons indicate that approximately twice the investment would be required on the irrigated farms, a further comparison was made with a 1,060-acre dryland cattle-hog farm. This 1,060-acre dryland farm would require approximately the same total average investment as the 480-acre irrigated farm. Consequently, this comparison furnished an indication of returns from equal investment in a dryland farm and an irrigated farm. Labor income on such a partly irrigated cattle-hog farm (buying additional feeders) would be about $9,300 compared to $8,800 on the dryland cattle-hog farm (Table 5). Labor requirements would be 393 man-days on the partly irrigated farm and 295 on the dryland farm.

Stabilizing Effects

Another phase of the study involved a determination of the probable stabilizing effect of irrigation upon incomes and production in a period in which production fluctuated as it did from 1926 to 1952. Certain simplifying assumptions were made:

(1) That prices would remain constant;

(2) That yields for dryland crops would vary from year to year in much the same way that they did from 1926 to 1952 in Beadle County, as reported by the Crop Reporting Service;

(3) That yields of irrigated crops, although at a different average level, would vary in much the same way from year to year as they did for the years 1926 to 1952 for the Belle Fourche Irrigation Project, as reported by the Bureau of Reclamation;

(4) That cattle sales and costs would vary directly with the previous year's pasture production;

(5) That hog and poultry sales and costs would remain constant at 30 litters of pigs and 100 hens;

(6) That costs of tractor operation, machinery operation, and hired labor would remain constant.

Such a comparison of the 480-acre partly irrigated cattle-hog farm and the 1,060-acre dryland cattle-hog

Continued on page 104

Table 4. Comparison of a 480-Acre Cattle-Hog Farm Under Dry Farming and Under Partial Irrigation, Central South Dakota, Projected Price Level*

Item	Dry Farm	Partial Irrigation†	
		Cattle Raised	Cattle Raised Plus Feeders Purchased
Dry cropland (acres)	330	42	42
Irrigated crops (acres)	-----	225	232
Irrigated pasture (acres)	-----	63	56
Native pasture & hay (acres)	145	145	145
Other land (acres)	5	5	5
Total (acres)	**480**	**480**	**480**
Beef cows (number)	7	37	17
Feeders purchased (number)	-----	-----	59
Sows (number)	30	30	30
Poultry (number)	100	100	100
Labor used, oper. (man-days)	180	262	243
Labor used, hired (man-days)	-----	146	150
Total investment (dollars)	27,899	55,616	55,231
Total receipts (dollars)	11,165	19,925	26,938
Total expenses (dollars)	5,276	10,445	14,926
Net cash income‡ (dollars)	6,505	10,383	12,909
Interest on investment§ (dollars)	1,350	2,725	2,702
Depreciation (dollars)	616	903	897
Net farm income‖ (dollars)	5,889	9,480	12,012
Labor and management income# (dollars)	4,539	6,755	9,310
Capital income** (percent)	15.6	12.5	17.0

*Hogs raised limited to 30 litters, cattle sold as slaughter cattle.

†Using Bureau of Reclamation estimate of $5 per acre of irrigable land for annual operation and maintenance charge; and $3 per acre for anual construction charge (deferred 10 years, then collected for 40 years).

‡Defined as total receipts less total expenses, not including depreciation or interest on investment.

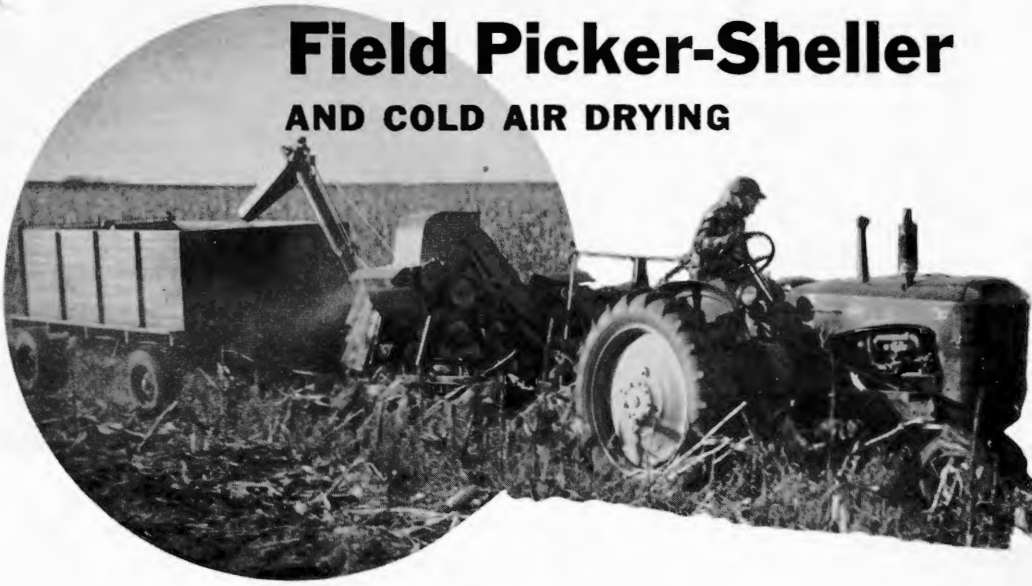
§At 4 percent on real estate and 6 percent on average investment in machinery and livestock.

‖Defined as total receipts less total expenses, not including interest on investment.

#Defined as total receipts less total expenses and interest on investment.

**Defined as net farm income less charge for operator labor (at $4.70 a day) and management (at 7 percent of total receipts less feeds and feeders purchased), and expressed as percentage of total investment.

Field Picker-Sheller
AND COLD AIR DRYING



H. H. DeLong

THE FIELD PICKER-SHELLER, combined with cold air drying, proved to be entirely workable for a season of good drying weather such as the fall of 1954. Field shelling of corn allows for a greater concentration of the grain, thus reducing bin space. Cobs are left in the field and the separate shelling operation is not needed.

However, there are some problems involved with this method. Usually the field shelled corn is too high in moisture content to store safely. Moisture must be reduced to 14 percent for good market grade or winter storage. For longer periods of storage it should be reduced to 12 percent moisture.

Two methods of drying are available—fast drying with heated air and slower drying with cold air. Although cold air drying takes longer, it requires less time on the part of the operator. In addition, each crib must be equipped with an air duct system.

Field Picker-Sheller Efficiency

A trial was conducted to determine the efficiency of a field picker-sheller in 1954. Three runs were made over a 133-foot distance. A summary of the test is shown in Table 1.

Picking started on October 18 when moisture was 23 percent and before the wind had caused many

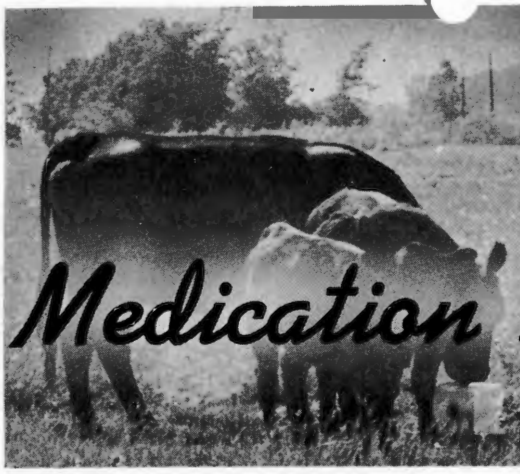
Table 1. Loss of Corn From Picker-Sheller Harvesting

Pregleaned* ear corn on ground	1.71%
Postgleaned† ear corn on ground	3.02%
Sheller loss on ground	4.19%
Other shelled corn on ground	2.22%
Total machine loss	**9.43%**
Total loss	**11.14%**
Corn in the load	88.86%
Total yield	69.8 bu/A
Yield brought in	62.2 bu/A

*Before picking.
†After picking.

Continued on page 105

Internal Medication



Wm. M. Rogoff

Cattle grubs are among the most important insect pests of livestock in South Dakota. The damage they do involves losses to the meat and hide industries as well as to cattlemen.

The adults or heel flies cause cattle to run during the egg-laying season in the spring and early summer. They generally lay their eggs on the legs and the lower parts of the body. The eggs hatch and the larvae burrow through the skin and start their long, 8- or 9-month stay in the bodies of the cattle. They spend this time in the connective tissue, wandering in the walls of various internal organs before reaching the back. There they form a cyst under the hide.

The paths of the larvae through the body can be followed by the severe inflammation along the route taken. The grubs remain in the back for about a month and then drop to the ground to pupate and change into adults or flies.

Present Control Methods

Present methods of control involve attacking these parasites when they are in the back. Spraying with rotenone, or rotenone washes or dusts, gives a fairly high level of control if repeated two to four times. However, to be effective such treatment must be undertaken in cooperation with practically all cattlemen in the area. Where treatment is applied on only one or a few ranches, the result is merely a form of revenge against the grubs; they have already done their damage, and little reduction would be expected the following year.

Cooperative treatment by cattlemen over large areas, however, can reduce the number of flies produced. Previous research at the South Dakota Agricultural Experiment Station and elsewhere has shown that such large-scale cooperative treatment can greatly reduce the number of grubs at the center of such areas.

(Two right pictures) Present cattle grub control methods are time consuming and ineffective unless done in the whole area. (Left) If an internal medication can be found, you may be able to control cattle grubs with chemicals that are added to salt or feed.

Limitations of this method include the considerable effort needed to get cooperation over large areas. Other difficulties involve the practical problems associated with applying several treatments to cattle during the worst part of the winter. Also the rotenone treatments are sometimes quite variable in their effectiveness. Thus it appears desirable to search for an improved procedure to control these insects.

New Research

Some entomological research centers are trying to kill the eggs or to kill the larvae before they have a chance to penetrate the skin. Encouraging results have been reported, and though many serious obstacles remain, a greatly improved procedure for the control of cattle grubs may result from this research.

The ideal solution to this problem appears to be a grub-killing chemical that can be added to salt or feed and made available to cattle during the fall of the year. The chemical can then be absorbed by the cattle, distributed to where the grubs are, and kill the grubs before they have had a chance to do much damage. A chemical of this sort would have to be relatively nontoxic to the animal when used in concentrations that would kill the parasites. It could leave no toxic residues which would interfere with the marketing of meat or milk.

Internal Medication. Several research stations have experimented with internal medication as a method of controlling cattle grubs. The best known work of this type was done at the U. S. Department of Agriculture laboratory at Kerrville, Texas. The Kerrville entomologists developed procedures for screening large numbers of chemicals in the laboratory. They tested the more promising chemicals against grubs transplanted into mice, as well as against natural infestations in cat-

tle. Many valuable leads have been developed as a result of their work.

Phenothiazine. Other research workers have investigated the possibilities of using phenothiazine for the control of cattle grubs. Phenothiazine is now widely recommended for the control of many helminth parasites in livestock. If it should prove useful against grubs as well it would be a discovery of great value to the stockman.

Professor A. N. Worden of Huntingdon, England, has published some encouraging results using a mixture of phenothiazine, hexachlorethane, and di-n-butyl tin dilaurate. Professor Worden has had some unaccountable failures, however, and it appears plain much work remains to be done.

Other encouraging work with phenothiazine has been reported from the U. S. Department of Agriculture laboratory at Auburn, Alabama. This work, while impressive, was based on so few animals that much additional data must be collected before definite conclusions may be drawn. Research reports from other sources are as yet inconclusive as regards the possible value of phenthiazine for grub control.

The Station Project

The South Dakota Experiment Station has undertaken a project to devise a method of controlling the young larvae before they reach the backs of cattle. The project consists of a search for new chemicals that will kill the grubs in the laboratory, and a program of field testing of the more promising chemicals in grub-infested cattle.

The laboratory phase of the project involves collecting the grubs, preparing the test media, and screening the candidate chemicals. The field phase requires the selection of presumably infested cattle, treatment of the animals, and evaluation of the results.

Collecting Grubs. One of the two species of cattle grubs found in South Dakota, the common grub (*Hypoderma lineatum*), can be found in considerable numbers in the connective tissue lining of the gullets of cattle. Infested gullets can be obtained at packing plants during the fall and early winter.

Routine procedure has been to visit the plant of John Morrell and Company in Sioux Falls the start of each week during the time larvae are found in the gullets. In Brookings the young larvae are dissected from the gullets and subjected to the effects of the various chemicals.

Testing Chemicals. Test chemicals are obtained mostly from insecticide and pharmaceutical companies, though some are obtained locally. They are added, at various concentration, to bovine serum in covered glass dishes, Five larvae are added to each dish, and the entire preparation is placed in an incubator for three days.

Grubs are examined at the end of 2 days and again at the end of 3 days. The number of dead larvae are recorded and the data obtained each time is compared to the mortality data in control dishes to which no test chemical was added.

Experiments conducted in the laboratory during the past 2 years

have uncovered 18 compounds that were toxic to all larvae tested when held for 72 hours at 100 p.p.m. (parts per million of the test chemical relative to serum). Of this number seven were toxic at 25 p.p.m. or below, and three were toxic at 10 p.p.m. or below. A total of 120 compounds have been studied.

Phenothiazine was not toxic to all larvae tested at 400 p.p.m. A sample of "Hypolin" containing phenothiazine, hexachlorethane, and di-n-butyl tin dilaurate also failed at 400 p.p.m., though a sample of the tin compound was toxic to all larvae tested at 10 p.p.m.

Limitations. It should be realized that laboratory screening procedures such as this have great limitations. The obvious advantage is that a great many compounds can be studied in a short time and at much lower cost than corresponding tests run in cattle. The biggest disadvantage is that conditions in a glass dish are far different from conditions within a cow. The next step after the laboratory selection, therefore, is to test the more promising chemicals against natural infestations of grubs in cattle.

Toxicity Tests. Before unknown chemicals can be used in cattle, something must be known of the way they affect mammals. Tests of various formulations of each chemical are first made on rabbits and later on sheep before cattle are given the treatment. Then before a number of cattle are treated, individual calves are exposed to each test chemical.

Tests in Cattle. During the 1954-55 experimental season, a group of 28 calves was kept at the College. These animals were obtained in the fall from central and western South Dakota from areas that normally have heavy infestations of cattle grubs. These presumably infested calves were then shipped to Brookings for treatment and observation.

The 28 calves were then weighed and assembled into seven lots of four animals each. One lot was used as a control and one lot was drenched with "Hypolin," the proprietary mixture of phenothiazine, hexachlorethane, and di-n-butyl tin dilaurate used by Worden in England. The other five lots were treated (either under the skin of the neck or by stomach tube) with the materials that looked best in the 1953-54 laboratory tests.

Efficiency of these tests was evaluated by four monthly extractions of grubs during January to April. The grubs were identified as to species to determine whether a chemical might be toxic to one species but not to the other.

Test Results. Results of this first year of field testing were negative. The calves in all seven lots were heavily infested with both species of grubs, and while some trends are apparent in the data, none of the treatments used can be regarded as successful. The "Hypolin" treatment was completely unsuccessful in these tests. Differences in susceptibility to the two species of grubs were not apparent.

An additional group of 12 presumably infested cattle were sub-

Continued on page 106

ener was used. As the amount of softener was increased to 1, soil removal was more effective. This also was the peak of efficiency.

Additional softener hindered soil removal as is shown by the downward slope of the lines in the chart. Apparently in excessively hard water it is necessary to use the proper amount of softener to get best results. Either more or less softener does not appear to be as effective.

More Detergent Needed in Hard Water

Synthetic detergents dissolve in hard water and produce good suds. Still, it is necessary to increase the amount used as the hardness of the water increases for more effective soil removal.

In water of zero grains hardness, 4 grams of synthetic detergent per liter did not remove more soil than did 2 grams per liter (Table 2). Four grams of synthetic detergent per liter effected more soil removal than did 2 grams in water of 30 grains hardness. This trend toward greater soil removal with increased amounts of synthetic detergent was even more pronounced at 60 and 120 grains of hardness.

A few of the soaps, softeners, and synthetic detergents tried in the launder-ometer were selected for use in a full-size washer. Soaps and softeners used in correct proportions and a synthetic detergent were about equal in removing soil in water at 35 grains and at 60 grains per gallon hardness (Table 3).

Since it was found that twice the amount of synthetic detergent was necessary for use in extremely hard water, the quantity of the synthetic detergent was doubled in water of 120 and 150 grains of hardness. The synthetic detergent removed more soil in this extremely hard water than the soap and softener. However, these results cannot be considered as conclusive evidence since it was not possible to collect more data at this time.

Table 2. Comparison of Results Obtained in Launder-ometer Using Different Amounts of Synthetic Detergent in Water of Varying Degrees of Hardness

Grains of Hardness	Units of Soil Removed	
	2 Gm. Synthetic Detergent/Liter	4 Gm. Synthetic Detergent/Liter
0	23.5	23.6
30	16.6	22.8
60	8.5	21.3
120	8.5	13.5

Homemaker and Laboratory Results Compared

A number of homemakers throughout the state have been interviewed on their particular laundry problems. In several of these homes soiled samples were laundered along with the regular family washing. These samples were read at the laboratory before and after washing to determine the amount of soil removed.

Methods, machines, and types and amounts of detergents varied somewhat. Still it was necessary in all cases for improved washing results to increase the amount of soap or synthetic detergent as water hardness increased. The results obtained in home washing corresponded closely to the findings in the launder-ometer studies.

Further work will be necessary

before definite recommendations for the use of soap, softeners, and synthetic detergents can be made. (Project 193. Leaders: O. E. Olson and G. F. Gastler, Station Biochemistry Dept; Lillian Lund, Home Economics Dept; D. F. Breazeale, Dairy Dept.)

Table 3. Comparison of Results Obtained Using a Soap and Softener with Those of a Synthetic Detergent in a Home Size Conventional Type Washer and Water of Varying Degrees of Hardness

Grains of Hardness	Soap and Softener		Synthetic Detergent	
	2 Gm.* Soap/Liter	4 Gm.† Soap/Liter	2 Gm.* Deter./Liter	4 Gm.† Deter./Liter
35	15.7	------	16.7	------
60	9.7	------	11.1	------
120	------	12.1	------	19.8
150	------	7.0	------	13.0

*100 grams of soap or synthetic detergent measured approximately 1¼ cups. This quantity was used in 50 liters of water which approximates 13¼ gallons .
†200 grams of soap or sqnthetic detergent were used in 50 liters of water or approximately 2½ cups in 13¼ gallons of water.

Cobalt in Our Grasses *Continued from page 85*

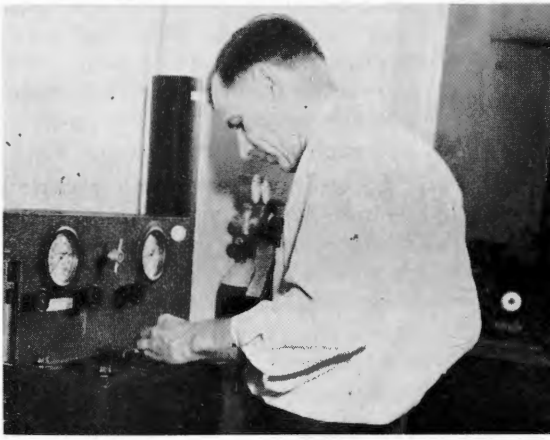
Table 1. Cobalt in Western Wheatgrass

Where Collected	Number of Samples	Cobalt Content (parts per million)	
		Range	Average
North Central Substation, Eureka	3	0.042-0.057	0.050
Central Substation, Highmore	21	0.027-0.250	0.080
Reed Ranch, Presho	6	0.040-0.320	0.117
Range Field Station, Cottonwood	20	0.014-0.088	0.049
Antelope Range Field Station, Buffalo	17	0.020-0.176	0.062

ciencies have been encountered or not. There is logic behind this, for borderline deficiencies may indeed reduce weight gains or feed efficiency. The relatively small difference in cost between ordinary and trace mineralized salt is inexpensive insurance against borderline deficiencies.

Results of the work discussed indicate cobalt supplementation of animals on the range may be needed. The easiest means of supplementation is through the use of trace mineralized salt. (Project 180. Leader: G. F. Gastler, Station Biochemistry Dept.)

The final step in measuring cobalt in grass.



VITAMIN A

SUPPLEMENTATION OF RANGE COWS

JAMES K. LEWIS

VITAMIN A is an essential nutrient for all animals; however, it does not exist in the plant world. Carotene, which is present in forage, is converted to vitamin A by the animal.

Carotene values of our range grasses are quite high early in the growing season but decline to very low levels in the winter. When the carotene content of the feed is high, cattle store vitamin A, principally in the liver. This reserve supply is used up during periods of low carotene intake and may be large enough following a favorable growing season to prevent vitamin A deficiency symptoms during an average winter.

Several workers have reported vitamin A deficiency in range cattle while others have been unable to produce a deficiency under normal range conditions. The carotene intake during the growing season and winter stress conditions on the animal would affect the results. Since these factors may be quite variable in South Dakota, a study of the response of range cattle to vitamin A supplementation during the winter feeding period was started.

The Plan

A series of trials was begun in the winter of 1952-53 to compare the longtime production of beef cows wintered on range and supplemented daily with 0, 1,000, or 3,000 U.S.P. units of vitamin A for each 100 pounds of body weight. The first level of supplementation is the total daily amount recommended by the National Research Council to prevent gross clinical symptoms of vitamin A deficiency. The second level is the amount recommended to provide for reproductive needs and moderate storage.

Winter Phase. Fifty-four high grade yearling Hereford heifers were bought in 1952 and permanently assigned at random to three levels of winter vitamin A supplementation and to three rates of sum-

mer grazing. The winter and summer treatments were replicated and balanced.

Nine animals were placed in each of six groups which were winter-grazed on comparable range pastures. These pastures have been deferred each year for winter grazing and are in excellent condition. The cattle were rotated from pasture to pasture every 2 weeks to compensate for pasture differences.

They were fed daily a 38 percent protein supplement composed of 87 percent solvent process soybean oil meal, 5 percent cane molasses, 8 percent dicalcium phosphate[1]. It contained a sufficient vitamin A supplement[2] to add 0, 1,000, or 3,000 U.S.P. units of vitamin A for each 100 pounds of body weight.

During the winters of 1952-53 and 1953-54, this supplement was fed at the rate of 1 pound a head daily from about December 1 until about May 1, while in 1954-55 it was fed at the rate of 1½ pounds a day. Late-cut prairie hay was fed in amounts that the cattle would clean up readily when grazing was impractical during storms or because of snow cover. This hay was cut after frost so that it would be similar to the forage on the winter range.

Summer Phase. For the summer phase of the study, nine animals were allotted to each of six comparable summer pastures. The pastures had been grazed heavily, moderately, or lightly from about May 1 through December 1 each year since 1942 and correspondingly were in fair, good, or excellent condition.

Six of these animals were designated as record animals for measuring pasture production. The other three animals were designated as "put and take" cows. They were added to or removed from the pasture to secure a utilization of 35-55 percent under moderate grazing, less than 35 percent under light grazing, and more than 55 percent under heavy grazing.

It was planned that all of the record animals should complete the grazing season even though in dry years this might mean heavier use than desired. The cattle had access to well water, iodized salt, and a salt-dicalcium phosphate mineral mixture containing at least 10 percent phosphorus.

The cows were bred to calve as 3-year-olds. Two closely-related bulls were used and each served the cows in a heavily, a moderately, and a lightly grazed pasture. The calves were weighed at birth and at monthly intervals until they were weaned about November 1. The cows were weighed each month throughout the year. Blood samples were taken in December, January, and March of each year for vitamin A, carotene, and phosphorus determinations.

Results and Discussion

No symptoms of vitamin A deficiency have been observed in any of the cows or calves during the 3 years that this study has been conducted. No differences attributable to feeding different levels of vitamin A in the supplement were observed in the calf crop, birth weights, wean-

[1]In 1954-55, dicalcium phosphate composed 5.6 percent of the mixture and soybean oil meal 89.4 percent.
[2]NOPCAY Type III micratized vitamin A supplement containing 10,000 U.S.P. units of Vitamin A per gram was furnished by the NOPCO Chemical Co.

ing weights, or in the general well-being of the cows or calves.

Blood Studies Show Differences. The only important differences have been found in the blood studies. Levels of vitamin A, carotene, and phosphorus in the blood plasma of these cows in October 1952 before they were placed on experiment are shown in Table 1. The levels of these three nutrients in the plasma near the end of each winter (March) are shown in Table 2 and the levels at the end of the summer grazing period (December) are presented in Table 3.

Large Yearly Differences. Yearly differences in the plasma vitamin A and carotene values were large. Climatic variations and the accompanying changes in the quality of the forage were largely responsible for this. The fall and early winter of 1952 were dry. Only 1.64 inches of

Table 1. Pretreatment Levels of Vitamin A, Carotene, and Phosphorus in the Blood Plasma of Cows Which Were Later Summer-Grazed at Different Intensities and Supplemented with Different Levels of Vitamin A on Winter Range

Level of Vitamin A Supplementation	Intensity of Summer Grazing											
	Heavy			Moderate			Light			Mean		
	Vitamin A mcg %	Carotene mcg %	Phosphorus mg %	Vitamin A mcg %	Carotene mcg %	Phosphorus mg %	Vitamin A mcg %	Carotene mcg %	Phosphorus mg %	Vitamin A mcg %	Carotene mcg %	Phosphorus mg %
A_0	41.0	102.0	7.74	41.8	122.8	7.28	41.5	100.2	7.90	41.4	108.3	7.64
A_1	43.0	118.5	7.50	39.0	153.5	7.75	40.5	109.2	6.79	40.8	127.1	7.35
A_2	40.2	127.2	7.31	41.7	112.7	7.87	41.0	148.5	7.58	40.9	131.0	7.56
Mean	41.4	115.9	7.52	40.7	131.2	7.61	41.0	119.3	7.42	41.1	121.9	7.52

Table 2. March Levels of Vitamin A, Carotene, and Phosphorus in the Blood Plasma of Cows Summer-Grazed at Different Intensities and Supplemented with Different Levels of Vitamin A on Winter Range (35 Cows Each Year)

Year / Level of Vitamin A Supplementation	Intensity of Summer Grazing											
	Heavy			Moderate			Light			Mean		
	Vitamin A mcg %	Carotene mcg %	Phosphorus mg %	Vitamin A mcg %	Carotene mcg %	Phosphorus mg %	Vitamin A mcg %	Carotene mcg %	Phosphorus mg %	Vitamin A mcg %	Carotene mcg %	Phosphorus mg %
1955												
A_0	23.8	28.2	5.25	26.0	37.0	4.89	20.0	35.2	4.06	23.2	33.5	4.73
A_1	28.5	26.0	6.98	26.2	50.0	6.25	32.8	30.5	6.46	29.2	35.5	6.56
A_2	22.8	24.2	6.40	25.7	28.7	4.38	25.5	33.0	4.71	24.5	28.6	5.23
Mean	25.0	26.2	6.21	26.0	39.5	5.24	26.1	32.9	5.08	25.7	32.7	5.52
1954												
A_0	21.0	25.2	6.09	20.5	34.0	5.87	17.5	36.2	4.94	19.7	31.8	5.63
A_1	20.2	24.5	8.97	18.5	36.0	6.96	20.5	20.8	7.25	19.8	27.1	7.73
A_2	21.8	29.0	6.73	22.7	37.3	3.90	23.0	28.5	5.86	22.4	31.1	5.64
Mean	21.0	26.2	7.26	20.4	35.6	5.73	20.3	28.5	6.02	20.6	30.0	6.35
1953												
A_0	15.2	15.8	7.42	17.5	20.8	6.02	17.0	19.2	6.18	16.6	18.6	6.54
A_1	21.8	17.0	7.98	19.8	20.0	8.30	21.2	14.5	7.32	20.9	17.2	7.87
A_2	25.5	17.5	6.70	27.0	13.3	6.07	24.2	16.8	6.92	25.5	16.1	6.61
Mean	20.8	16.8	7.37	20.9	18.5	6.86	20.8	16.8	6.81	20.9	17.3	7.02
All years												
A_0	20.0	23.1	6.26	21.3	30.6	5.59	18.2	30.2	5.06	19.8	28.0	5.64
A_1	23.5	22.5	7.97	21.5	35.3	7.17	24.8	21.9	7.01	23.3	26.6	7.39
A_2	23.3	23.6	6.61	25.1	26.4	4.78	24.2	26.1	5.83	24.2	25.3	5.83
Mean	22.3	23.1	6.95	22.4	31.2	5.95	22.4	26.1	5.97	22.4	26.6	6.30

Table 3. December Levels of Vitamin A, Carotene, and Phosphorus in the Blood Plasma of Cows Summer-Grazed at Different Intensities and Supplemented with Different Levels of Vitamin A on Winter Range

Level of Vitamin A Supplementation Year	Intensity of Summer Grazing											
	Heavy			Moderate			Light			Mean		
	Vitamin A mcg %	Carotene mcg %	Phosphorus mg %	Vitamin A mcg %	Carotene mcg %	Phosphorus mg %	Vitamin A mcg %	Carotene mcg %	Phosphorus mg %	Vitamin A mcg %	Carotene mcg %	Phosphorus mg %
1954												
A_0	25.2	133.5	5.25	26.2	120.0	8.70	51.5	509.5	5.31	34.3	254.3	6.51
A_1	23.5	104.0	8.26	26.2	148.8	6.52	52.8	518.0	6.07	34.2	256.9	6.95
A_2	26.2	103.0	5.96	31.7	154.0	5.59	54.2	591.8	4.44	37.9	294.6	5.31
Mean ..	25.0	113.5	6.58	27.7	139.7	7.06	52.8	539.8	5.27	35.4	267.9	6.28
1953												
A_0	18.8	59.5	5.45	18.2	59.8	6.63	25.2	137.5	5.72	20.8	85.6	5.93
A_1	19.8	61.2	7.63	18.2	63.2	8.90	32.0	121.8	5.63	23.3	82.1	7.39
A_2	21.5	65.5	6.85	20.0	64.0	7.35	26.8	149.8	5.39	23.0	95.7	6.45
Mean ..	20.0	62.1	6.64	18.7	62.2	7.65	28.0	136.3	5.58	22.3	87.6	6.60
Both years												
A_0	22.0	96.5	5.48	22.2	89.9	7.66	38.4	323.5	5.51	27.5	170.0	6.22
A_1	21.6	82.6	7.94	22.2	106.0	7.71	42.4	319.9	5.85	28.8	169.5	7.17
A_2	23.9	84.2	6.40	25.8	109.0	6.47	40.5	370.8	4.91	30.5	195.2	5.88
Mean ..	22.5	87.8	6.61	23.2	101.0	7.36	40.4	338.0	5.43	28.9	177.7	6.44

precipitation were received from August 1 to January 1, 1953. The dry fall was reflected in lower plasma carotene and vitamin A values of the unsupplemented cattle reported for March 1953 (Table 2).

The falls of 1953 and 1954 were favorable for late growth of forage. The precipitation was 1.98 inches in October 1953 and 2.50 inches in October 1954. Favorable rains were followed by warm days in November in both years. This produced new growth of cool season grasses and germination of winter annuals, especially Japanese bromegrass. Plasma vitamin A and carotene values were high in December 1953, and were exceptionally high in 1954 in those cows that were grazed on the lightly-grazed pastures.

The plasma vitamin A values for the different rates of grazing in December 1954 were 25.0, 27.7, and 52.8 micrograms per 100 milliliters, respectively, for heavy, moderate, and light rates of grazing. The corresponding values for plasma carotene were 113.5, 139.7, and 539.8 micrograms per 100 milliliters.

Cool Season Grasses. Higher values for cattle on lightly-grazed pastures were probably due to the larger proportion of cool season grasses present in the pastures which were in excellent condition. These grasses make fall regrowth and extend the green feed season when moisture is plentiful.

In both 1953 and 1954 conditions were favorable for the germination and growth of Japanese bromegrass. In late November of 1954, this invader was about 1 inch high. It was very abundant on the lightly-grazed pastures but was rather infrequent on the heavily and moderately grazed units. This difference in abundance was probably due to the fact that most of the plants were consumed the previous year on the more heavily-stocked units and, consequently, there was a limited seed supply.

Japanese bromegrass is an undesirable plant on the range, but it composed part of the diet of the cattle on the lightly-grazed units in the fall. It was undoubtedly responsible in part for the high plasma vitamin A and carotene values observed in December. Although differences in plasma vitamin A and carotene were large in December, the differential effect of the summer treatments was not apparent by the end of the winter. Likewise, there was no important effect of different levels of vitamin A supplementation during the winter on plasma levels of the vitamin the following December.

Winter Conditions. The winters of 1953-54 and 1954-55 were open and mild. Hay was fed only 3 days during 1953-54 and none was required in 1954-55. In both years plasma vitamin A levels remained high at the January sampling but showed lower values by March. However, during February and early March of 1953, the cattle were unable to graze 27 days because of snow cover. They were fed an average of 14.6 pounds a head daily of hay containing 6.20 micograms of carotene per pound. This was poor quality hay with low carotene content. However, when fed in this amount, it supplied more than enough carotene to meet the recommended allowance of the cattle in all lots.

The effects of the different levels of vitamin A supplementation were thus partially obscured. The carotene and vitamin A values at the midwinter sampling in January 1953 were lower than those reported for March in all lots. This was the only year in which the vitamin A levels in the plasma reached levels considered to be borderline for reproduction by some workers.

Vitamin A Supplement. The average plasma vitamin A values were higher each year in the lots which received a vitamin A supplement. This difference was statistically significant. Plasma carotene levels were not affected by the vitamin A supplementation.

Plasma carotene levels were high and were strongly correlated with plasma vitamin A at the December samplings ($r=0.96$).[3] However, by the end of the winter the carotene values were considerably lower than the December sampling. They were not strongly correlated with vitamin A, even in those animals which received no supplementation of vitamin A ($r=0.43$).

These observations would suggest that the cattle receiving no vitamin supplement were mobilizing vitamin A reserves to maintain about normal plasma vitamin A levels. This was substantiated at the March sampling in 1954 by the use of an ethyl alcohol drench.

Other workers have reported that a large dose of alcohol will mobilize vitamin A reserves in the liver and thus increase plasma vitamin A values. Each cow was drenched with 95 cc. of 50 percent solution of ethyl alcohol for 100 pounds body weight. They were bled before and 4 to 6 hours after drenching. The increase in plasma vitamin A between the two bleedings was used as an indication of the liver reserves of the animal. This technique indicated

[3] $r=1.00$ would mean that the two values were perfectly correlated while $r=0.00$ would mean the two values were not related.

that none of the animals were depleted, but the increases were slightly larger in the supplemented than in the unsupplemented lots.

Phosphorus Levels. The levels of phosphorus in the blood plasma did not show large differences in response to the experimental treatments. This was expected since a uniform level of phosphorus was added to the protein supplement in the winter and a phosphorus supplement was available from the salt box in the summer. However, the phosphorus levels in the blood plasma were inversely correlated with the plasma carotene at the December sampling, although the relationship was not strong ($r=-0.28$). The plasma values of the nutrients were unrelated at the March sampling.

Summary

Grade Hereford cows have been winter-grazed on the range for three winters and supplemented with 0, 1,000, or 3,000 U.S.P. units of vitamin A for each 100 pounds body weight daily. It was fed in the protein supplement. They have been summer-grazed at heavy, moderate, or light intensities for 2 years on pastures averaging fair, good, or excellent condition, respectively. No differences due to the vitamin A intake were observed except that the blood plasma content of vitamin A at the end of the winter was generally higher in the lots which received supplemental vitamin A. The carotene and vitamin A content of the blood plasma at the beginning of the winter was higher in the cattle from the lightly-grazed summer pastures.

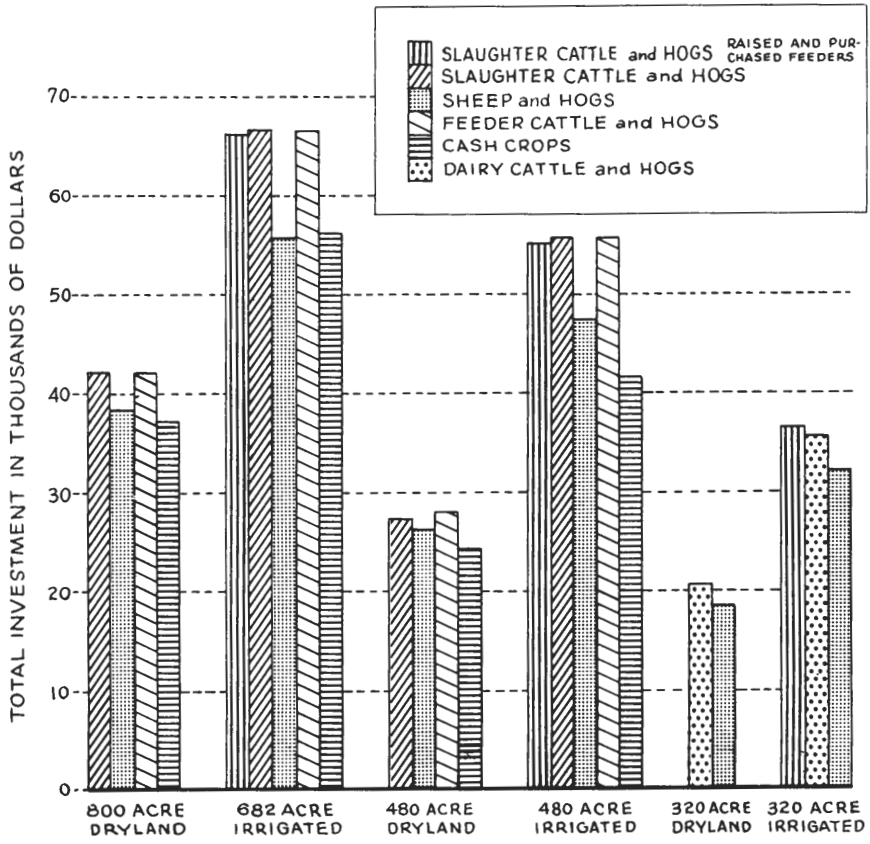
Animals are less likely to become deficient in vitamin A when grazed on ranges in excellent condition, especially when growing conditions in the fall are favorable for cool season range plants. A full feed of hay, even though it is of rather poor quality, may supply a significant amount of the animal's carotene, or vitamin A, requirement.

This study is being continued with the same animals on the same treatments. (Project 217. Leaders: J. K. Lewis, Animal Husbandry Dept.; O. E. Olson and Frances M. Moyer, Station Biochemistry Dept.)

Cows on winter range receive supplemental feed containing vitamin A.

Will Irrigation Pay *Continued from page 90*

Comparison of total investment for various organizations and sizes of farms under dryland and partial irrigation, central South Dakota, calculated on projected price level.



farm indicated that irrigation would reduce fluctuations in income by 70 percent and in feed production by 69 percent.

Information on the other sizes of farms and organizations considered in the cooperative study, as well as the problems likely to be encountered in changing from dryland to irrigation farming, is presented in South Dakota Agricultural Experiment Station bulletin 444. However, a farmer who is interested in comparing the profitability of his present dryland farming operations with irrigated farming on his farm needs to work out plans for his own situation. The results reported in this study represent averages for typical situations, and, in general, they will need to be modified to fit individual situations. (Project 198. Leader: Rex D. Helfinstine, Economist, USDA.)

Table 5. Comparison of a 1,060-Acre Dryland Cattle-Hog Farm and a 480-Acre Partly Irrigated Cattle-Hog Farm, Central South Dakota, Projected Price Level*

Item	1,060-Acre Dryland Farm	480-Acre Partly Irrigated Farm†
Dry cropland (acres)	733	42
Irrigated crops (acres)	-----	232
Irrigated pasture (acres)	-----	56
Native pasture and hay (acres)	322	145
Other land (acres)	5	5
Total (acres)	**1,060**	**480**
Beef cows (number)	20	17
Purchased feeders (number)	-----	59
Sows (number)	30	30
Poultry (number)	100	100
Labor used, oper. (man-days)	236	243
Labor used, hired (man-days)	59	150
Total investment (dollars)	55,148	55.231
Total receipts (dollars)	20,708	26,938
Total expenses (dollars)	9,318	14,926
Net cash income‡ (dollars)	12,341	12,909
Interest on investment§ (dollars)	2,591	2,702
Depreciation (dollars)	951	897
Net farm income‖ (dollars)	11,390	12,012
Labor and management income# (dollars)	8,790	9,310
Capital income** (percent)	16.2	17.0

*Hogs raised limited to 30 litters; cattle sold as slaughter cattle.

†Using Bureau of Reclamation estimate of $5 per acre of irrigable land for annual operation and maintenance charge and $3 per acre for annual construction charge (deferred first 10 years, charged next 40 years).

‡Defined as total receipts less total expenses, not including depreciation or interest on investment.

§At 4 percent on real estate and 6 percent on average investment in machinery and livestock.

‖Defined as total receipts less total expenses, not including interest on investment.

#Defined as total receipts less total expenses and interest on investment.

**Defined as net farm income less charge for operator labor (at $4.70 a day) and management (at 7 percent of total receipts less feed and feeders purchased), and expressed as percentage of total investment.

Field Picker-Sheller *Continued from page* 91

ears to fall. The sheller had to be set to break the cobs into fine pieces because of the many small ears and the light yield over high ground. This caused some loss from the separator unit.

Cold Air Drying

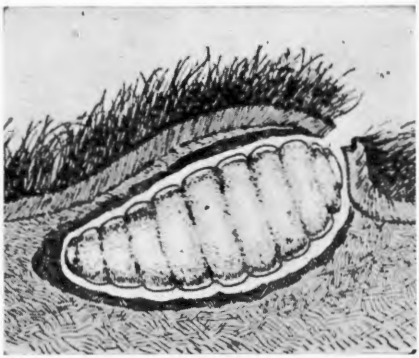
On October 22, after enough corn was in the bin to cover the ventilator ducts, a cold air fan was started. It ran continuously until November 19 (28 days), at which time the corn tested 14 percent moisture.

The drying equipment consisted of metal ducts on the floor of a 1,000-bushel steel grain bin. The ducts provided an even air flow to all parts of the bin. A 3-horsepower electric motor and backward curved radial flow fan was used. This fan could have been used for two or three bins at the same time for cold air drying.

During the 28 days of running there was some cold weather but few rainy days. Drying conditions were favorable. Years when conditions are similar to 1954, field picker-sheller work with cold air drying seems to be an efficient way of harvesting corn. (Project 246. Leader: H. H. DeLong, Agricultural Engineering Dept.)

jected to further studies on phenothiazine. These animals were being used in a nutrition experiment, thus the phenothiazine tests were incidental. Phenothiazine was added to the feed of six animals; the other six were held as controls.

Unfortunately the calves were very irregular in their feeding. This was true of the controls as well, so phenothiazine is not incriminated. There was no significant difference in number of grubs between the treated and the untreated calves. No conclusions can be drawn from this phenothiazine experiment.



Third stage grub encysted under the skin.

Search Continues. The search for an internal medication to control cattle grubs before they reach the backs of cattle will continue. Research in this field is still in its early stages. Great numbers of chemicals that prove successful under laboratory conditions may have to be abandoned. They may fail to kill the larvae within the animals, they may cause undesirable effects in cattle, or they may leave a residue that is unwelcome in human food. While the chances of failure are high, the value of success would be so great to the livestock producers, the packers, and the leather industry that continued work along these lines is justified. (Project 244. Leader: Wm. M. Rogoff, Entomology-Zoology Dept.)

Tanned cowhide showing holes made by grubs.

effects of TWINNING in dairy cattle

CHASE WILSON

BIRTHS OF TWINS in dairy cattle are not numerous, yet they occur often enough to cause some concern among dairymen. To determine the effects of twinning, an analysis was made of the dairy herd records at South Dakota State College. These records had been kept over a 50-year period.

During this period 70 cows gave birth to twin calves. The milk production records of these cows reveals some interesting information. All of these data have been converted to twice a day milking, 305-day lactation, and mature equivalent basis. The averages of these records are presented in Table 1.

Immediately following twinning the lactation averaged approximately 1,000 pounds of milk and 50 pounds of butterfat less than the records prior to and after twinning. Using a price of $4.44 a hundredweight for milk, this represents a loss of approximately $40 during the lactation following the birth of twins. In the case of purebred cattle the value of this extra calf may more than offset the reduction in milk income; however, in grade cattle, the extra calf may not pay for the loss in milk.

Effect on Cows. The comment is often heard among dairymen that after a cow has had twins, breeding difficulties and a lengthened interval between calvings are likely to occur. The records of these 70 cows were studied to obtain information on this point. It was found that after giving birth to a single calf these cows required 1.55 services for conception, but following the birth of twins 1.83 services were required. Thus, the length of time between calvings was increased, which usually means longer dry periods and less total milk produced.

Effect on Calves. A popular question about twins is whether or not they will be successful breeders. To answer this question it is necessary to consider the three types of births which may occur among twins, (1) both bulls, (2) both heifers, and (3) one heifer and one bull.

In general, when two bulls are born together they will be successful breeders. This is also true when two heifers are born together. However, when a bull and heifer are

twins, the heifer will be sterile or a nonbreeder in about 95 cases out of 100. These sterile heifers are known as freemartins.

Freemartins. About 95 percent of the heifers twinned with a bull are sterile because the heifer and her male twin are carried in the same fetal membranes in their dam. During embryonic life the male develops earlier than the female. This means the male starts secreting the male hormone (androgen) before the female secretes the female hormone (estrogen). Since both twins are in the same fetal membrane, they have a common blood supply. Therefore the male hormone is circulated through the blood stream of the female. As a result of the action of the androgen, development of the female organs is retarded. This prevents them from becoming fully developed and able to function in later life. Sometimes the whole reproductive tract appears to be developed, but it will not function normally. Regardless of the extent of underdevelopment of the reproductive organs, the freemartin cannot reproduce and will be of no value as a herd replacement.

Table 1. Milk Production Records of Cows Giving Birth to Twins

Description	Lbs. Milk	Percent Fat	Lbs. Fat
Before carrying twins	10,963	3.66	401.7
While carrying twins	11,644	3.34	388.9
Following twinning	9,673	3.51	339.5
Subsequent records	10,324	3.74	386.5

Approximately 5 percent of the heifers twinned with a bull are carried in separate fetal membranes. In these cases, each has its own blood supply independent of the other. Therefore the male hormone does not inhibit the development of the reproductive organs in the heifers. Two afterbirths will be present in these cases. The heifers are not freemartins and can be expected to reproduce normally.

Since a large percentage of the dairy cattle in the United States are not purebreds, twin calves represent a loss to their owner more often than a gain. Losses due to lower milk production and lower breeding efficiency are usually greater than the value of the extra calf. (Project 184-R. Leader: Chase Wilson, former Dairy Husbandman, Dairy Husbandry-Bacteriology Dept.)

In 95 cases out of 100, a freemartin such as the one pictured below will be a nonbreeder.

New Publications

B443 Quality Aspects of Butter Marketing in South Dakota. How we can improve the quality of South Dakota butter.

B444 Economic Potentials of Irrigated and Dryland Farming in Central South Dakota. A comparison of irrigated and dryland farming in the James River Valley.

B445 A Comparison of Linseed and Soybean Oil Meals and Methods of Feeding Growing-Fattening Pigs. Soybean oil meal shows up well in mixed rations.

B446 Antibiotics in Growing and Fattening Pig Rations. Antibiotic-supplemented rations get pigs to market sooner.

B447 Observations on Parasitism in Sheep in Northwestern South Dakota. Parasite control through good range management.

B448 Growth and Decline of South Dakota Trade Centers, 1901-51. Why some trade centers grow while others disappear, with history of changes in the half-century.

B449 Reconnaissance Soil Survey of Potter County, South Dakota. Discussion of soils of Potter County, estimated yields under different management practices, and irrigation potential of soils.

B450 Fifty Years Experience on the Belle Fourche Irrigation Project. Lessons learned on the Belle Fourche Project.

B451 Food Habits of South Dakota Women. Kinds and amounts of food eaten daily by South Dakota women.

B452 Farm Fly Control. New methods and chemicals for controlling flys.

C112 1954 South Dakota Corn Performance Tests. Yields of different varieties in every area of the state.

C113 Research in Crops and Soils, a Progress Report. Crop yields of different varieties and under different management practices.

C114 Chemical Control of Woody Plants. Methods of applying chemicals for control of common woody plants.

C115 Effects of Irrigation on an Adjoining Ranch Economy. Benefits of irrigation to the neighboring dryland ranches.

C116 Agricultural Research at the Range Field Station, a Progress Report. A report on research at the Cottonwood Range Field Station.

C117 Share Rents and Short-Term Farm Leases. Discusses long- and short-term farm leases, the merits and disadvantages of each.

These publications can be obtained from your county agent or by writing the Experiment Station Editorial Office, South Dakota State College, College Station, Brookings, South Dakota.

1955

Agronomy Field Day

The topic at this stop is sweet clover.

Farmers and ranchers—about a thousand—came to the agronomy farm at Brookings July 7 to see first-hand the advancements in crops research.

These people looked over the new grain developments, such as Ransom, one of the new oat varieties being increased. The result of cooperative work between North and South Dakota, Ransom is early, stem rust resistant, stands up well, and has had good test weights.

Durum wheats are being developed that are resistant to Race 15-B of stem rust, yet yield a good crop of acceptable macaroni wheat. Field day visitors examined plots of durum that may be released this fall.

Winter wheat makes up about 12 percent of the South Dakota wheat acreage. The problem is to get better winter-hardiness. One staff member told the group that a winter wheat as hardy as rye would mean an additional income of $20 million a year—certainly a cause for expanded research.

But these farmers and ranchers saw that it's not just the variety and weather conditions that make a crop. Soil fertility and cultural practices as well as proper weed, insect, and disease control measures can have a great influence on yields.

Farmers examine Ransom, a new oat variety, at the annual agronomy field day.